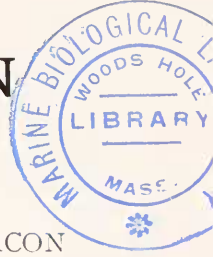


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## A STRONGLY INTERSEXUAL FEMALE IN *HABROBRACON*

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In the parasitic wasp *Habrobracon juglandis* (Ashmead), diploid males have never shown any tendency toward intersexuality; they are as definitely male as their normal haploid brothers. When a "diploid male with female genitalia" was found, it was therefore regarded with especial interest. The specimen, designated freak 994, developing from a heavily x-rayed (29,300r) egg, occurred among the offspring of a treated wild type (stock 33) female crossed with an untreated lemon honey male (Experiment by A. R. Whiting, 1945).

Freak 994 shows the heterozygous condition of the semidominant body color gene lemon inherited from its father. (Note light base of antennae in Figure 1.) The number of its antennal segments and its large ocelli are male characteristics. It was to be expected, therefore, that male reproductive reactions would occur. Several tests at different times failed to evince any response toward females although the specimen appeared healthy, drank honey water and lived for several days until fixed in Carnoy fluid. Since it likewise failed to give any response (female) to caterpillars, its indifference was probably not due to its sex type but to some unknown factor.

Because of the small "feminized" genitalia on the "male" body, freak 994 was at first recorded as a "diploid gynandroid male." Gynandroids, however, have always been haploids. They are mosaic males in which the two sexually different types of male tissue react in a complementary way to feminize the external genitalia (Whiting, Greb, and Speicher, 1934). Their mosaicism is shown by their asymmetry, not only in body color, in number of antennal segments, in mutant traits, and often in wing length, but especially in the external genitalia which are a mixture of normal male and feminized male structures with much reduplication and irregularity. In freak 994 there are no male genital structures and the female genitalia, consisting of a pair of sensory gonapophyses with no visible sting, are symmetrical and larger than in gynandroids. They are much smaller, however, than the female genitalia found in gynanders which are male-female mosaics with clearly separated male and female regions. That freak 994 is not a sex mosaic is shown by its symmetry in body coloration, in antennal flagella with nineteen segments in each and in length of wings and legs.

Two types of intersexes have hitherto been reported in *Habrobracon*. (1) Gynoid, dependent upon a single mutant gene, is a weakly intersexual male, functioning normally as a male, but having certain external traits, including antennae, feminized. (2) Nine intersexual females were reported (Whiting, 1943) occurring in a single fraternity. "Superficially, these appear to be the reverse of the gynoid

males, being more masculine anteriorly, feminine posteriorly." They resemble freak 994 in head and thorax and in the anterior part of the abdomen which are altogether like those of the male. In the posterior region, however, the sclerites are thickened, there is a normal sting and the sensory reproductive appendages are of full length characteristic of the female. "The nine intersexual females must be



FIGURE 1

regarded as more strongly intersexual than gynoid males since antennae, ocelli and instincts are completely sex reversed." Freak 994 is an intersexual female, comparable to these nine but still more strongly intersexual because of greater restriction of the "female" region and reduction of the genitalia.

In *Habrobracon*, normal haploid males have cells almost as large as the corresponding cells of diploid females and in some stocks they are actually larger (Grosch,

1945). Cells of diploid males are much larger than are those of females or of haploid males. These relationships have been determined by counts of microchaetae within a given area on the upper surface of the wings, each microchaeta corresponding to a single cell. Study of the dispersion of microchaetae in freak 994 showed its cell size to be within the range for the female or haploid male and therefore much smaller than that characteristic of the diploid male. The marked shift of the intersex in the male direction does not then affect the size of its cells. It may be fundamentally female, heterozygous for the sex factor. This condition perhaps prevents the abnormal expansion of cell size while permitting development of antennae and ocelli of normal male type.

The nine intersexual females previously reported had internal abdominal structures as in the female with normal poison sac and glands and seminal receptacle. Each ovary, however, appeared to be a pair of sacs of oogonia showing no differentiation of nurse cells and ova. Serial sections were made of the abdomen of freak 994 and the internal structures were studied. The digestive tract is entirely normal with the crop greatly distended from honey water feeding. A poison apparatus is present but imperfectly developed and situated near the median plane, directly dorsal to the compound posterior nerve ganglion instead of being shifted laterad to the digestive tract. The poison glands are normal although of somewhat small size. Their ducts converge to a common duct connecting distally with an imperfect poison "sac" and proximally traversing the very short distance to the region where normally lies the root of the sting. The poison "sac," of approximately normal length, is reduced in diameter to an irregularly sclerotized strand. It is surrounded by longitudinal muscles as in a normal female. Nothing corresponding to a seminal receptacle could be located, nor were any gonads to be found. The fat body appears normal, surrounding the digestive tract and the poison apparatus dorsally and laterally.

#### DISCUSSION

In the report on the nine intersexual females, it was suggested that they might be accounted for by a dominant mutation in a sex allele changing  $xb$  to  $xb^m$ . The intersexes would then be modified females,  $xa\ xb^m$ . A similar hypothesis would cover freak 994, but here the mutation may have been x-ray induced and more potent than in the previous case so that the intersexuality would be more extreme with turning-point earlier in development.

Failure to find gonads in freak 994 does not necessarily mean that they were lacking from the beginning for they may have begun development and then disintegrated.

Comparison may be made between freak 994 and certain types of "deficient" individuals previously reported in *Habrobracon* (Whiting, 1926). Some of the "deficient" had external genitalia lacking but gonads present. Others had testes of reduced size, or present on one side, lacking on the other. Some of the "deficient" females with no trace of poison apparatus had well differentiated ovaries with eggs and nurse cells. This is just opposite to the condition found in the intersexual female, freak 994. There was no intersexuality among the "deficient."

## SUMMARY

An intersexual female developed from a heavily x-rayed egg fertilized by an untreated sperm. The specimen is more strongly intersexual than a group of nine previously reported, for its external female genitalia are much reduced, its poison apparatus defective and its ovaries altogether lacking. Externally, it appears like a diploid male with small female genitalia.

It is suggested that the x-radiation may have caused a change within a sex-differentiating allele, so that the heterozygote would develop into an intersex rather than a normal female.

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